for its presence, and the methods for its quantitative estimation. The quantitative estimation is illustrated in a majority of the cases by an example, so that the student can not go astray. Perhaps in some of these cases the calculations could have been omitted, for many are so simple that any one who could understand the directions should be able to calculate percentage, etc., but it is better to err in being too explicit rather than be too obtuse.

The literature has been well reviewed, but, unfortunately, the book contains no author index, so that the numerous author citations lose a very considerable part of their value. It is to be hoped that this feature will be remedied in a second edition.

The book is well printed on good paper, and is remarkably free from typographical errors. It should prove a useful volume to the average chemist, and invaluable to the plant physiologist or the teacher of plant chemistry, both as a reference book and as a text-book. Needless to add it should be in every chemical library.

ROSS AIKEN GORTNER

SPECIAL ARTICLES

THE ORGANIZATION OF THE CELL WITH RESPECT TO PERMEABILITY

IN studies on permeability it is assumed that we need consider but one surface, namely, the outer "plasma membrane." It seems desirable to emphasize that the problem really involves a variety of surfaces[1] the permeability of which may be decidedly different.

Good illustrations of this may be found in many kinds of plant cells. A very favorable object for investigation is afforded by the marine alga *Griffithsia.* Within the cell wall is a thin layer of protoplasm which surrounds a large central vacuole. The protoplasm therefore forms a sack which is filled with liquid. It is capable of expanding or contracting as water is taken up or withdrawn by osmotic exchange.

If these cells be placed in hypertonic sea water water is withdrawn from the cells and the protoplasmic sack contracts: on replacing the cells in sea water the sack expands to its original size. If in place of hypertonic sea water we use hypertonic NH_4Cl the sack likewise contracts, but the inner wall of the sack contracts a great deal more than its outer wall. The space between the two surfaces which is normally very small may increase until in places it equals one third of the length of the cell.

There are, therefore, two surfaces, the outer surface of the protoplasm ("plasma membrane") and the inner surface (vacuole wall) which do not act alike with respect to permeability. The interpretation of their behavior may be twofold. In the first place, the outer surface may be regarded as more permeable to NH_4Cl than the inner. The salt would therefore cause the outer surface to contract less than the inner since it is well known that the more freely a substance penetrates the less is its plasmolyzing power.

On the other hand, we may have to do with an alteration of permeability produced by the NH_4Cl. If the NH_4Cl produces an increase of permeability it may cause a contraction by what has been called false plasmolysis.[2] If the false plasmolysis of the inner surface is greater than that of the outer the effect which we have witnessed may result.

It is of course quite possible that both of these interpretations are correct and that we have both true and false plasmolysis contributing to the result. The writer is inclined to think that this is the case.

By lowering the concentration of the NH_4Cl we can produce a marked contraction of the inner surface while the outer still retains its full turgidity and shows no sign of contraction. This is most strikingly shown where a living cell adjoins a dead one. The turgidity of the living cell causes its end wall to bulge into the dead cell. As soon as the living cell loses its turgidity the end wall ceases to bulge and becomes nearly flat. It is therefore easy to determine whether the cell is turgid or not.

[1] The term surface is preferred, since a semipermeable surface may exist where there is no definite membrane.

[2] Cf. *Bot. Gazette,* 46: 53, 1908; 55: 446, 1913.

Further experiments show clearly that false plasmolysis plays a part in this process, for hypotonic solutions or even tap water or distilled water may produce a contraction of the inner surface while the turgidity of the outer surface is maintained.

The chromatophores are numerous and lie embedded between the inner and outer surfaces of the protoplasmic sack. They contain chlorophyll and likewise a red pigment which is soluble in water. The red pigment is unable to escape from the chromatophore into the protoplasm under normal conditions because the surface of the chromatophore is impermeable to it. When the separation of the inner and outer surfaces of the protoplasm reaches a certain point the surface of the chromatophores usually becomes permeable to the red pigment so that it diffuses out. The cells then present a very striking appearance. The contracted vacuole remains colorless while all the space between the inner and outer surfaces of the protoplasm becomes deep red. The red pigment can not escape through the outer surface, nor can it pass through the inner surface into the vacuole. The cell may remain in this condition for an hour or two. Finally the red color begins quite suddenly to diffuse through both the protoplasmic surfaces.

The nuclei behave as though their surfaces were impermeable to the red pigment at the start, but they appear to become permeable to it soon after it begins to diffuse out from the chromatophores.

The cell wall which encloses the protoplasm is freely permeable to the red pigment and to salts at all times, but is quite impermeable to many other substances.

Similar effects have been observed in a variety of other cells.

Whether these effects are due to true or to false plasmolysis or to a combination of both, it is evident that the various kinds of surfaces (*i. e.,* the inner and outer protoplasmic surfaces, and those of the chromatophores, of the nuclei and the cell walls) can be proven to differ greatly in their behavior with respect to permeability.

The term differential permeability may be suggested as an appropriate designation of these phenomena.

The conception of differential permeability may perhaps be extended to surfaces other than those described here. Since the protoplasm is composed of a variety of structures (down to those which are ultramicroscopic) and each of these has a surface it is quite possible that many kinds of semi-permeable surfaces exist within the cell.

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THE SOCIETY OF AMERICAN BACTERIOLOGISTS. II

SANITARY BACTERIOLOGY

Observations upon the Bacteriology of the Baltimore City Water in Relation to the Typhoid Fever Present, and the Effect of the Hypochlorite Treatment: WILLIAM W. FORD and ERNEST M. WATSON.

Since October, 1910, up to the present time (December, 1912), a period of a little over two years, it has been possible for us to follow the bacteriological condition of the Baltimore city water by systematic examinations (weekly)—excepting for a brief period in the summer of 1911. These examinations have been of the nature of the bacterial count, the determination of the number of fermenting organisms present by means of the Smith tube, the isolation and determination of the various species present. The purpose of this work was (1) to determine the relation, if any, between the extent of the pollution and the amount of typhoid fever in the city, (2) to determine the seasonal variations in the bacterial content of the water and (3) to ascertain the effect of alum and hypochlorite of lime upon the city drinking water, as regards the bacterial content and later the effect of the purity or pollution of the water under these conditions upon the amount of typhoid fever in the city. It was found that in 1910 and 1911 there was a striking relation between the period of summer and fall pollution of the water and the summer rise in the amount of typhoid fever. The number of organisms in the water at this time ranged from 1,000 to 5,000 per cubic centimeter, and fermentation took place in 1/10 to 1/100 c.c.